



Permanent incorporation of technological tools to the development of mathematics classes

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Submitted on July 24th, 2019 / Accepted on September 27th, 2019

<https://doi.org/10.5377/torreon.v7i20.8576>

Keywords: ICT, technological tools, learning, mathematics

ABSTRACT

The article presents a proposal to teach mathematics, it raises the need to incorporate the use of ICT (Information and Communication Technologies) in the development of the contents of this subject. Although some teachers still practice only with pencil and paper, solid arguments are raised by which math teachers should start using these technological tools in their classrooms. The proposal explains the possible effects that its implementation will have, where the student's final performance, motivation and the search for meaningful learning are the main elements of the educational theories that best support the proposal. Finally, it is highlighted that the proposal is a product of the contribution of many mathematics teachers from the Regional Multidisciplinary College of Chontales UNAN-MANAGUA, Nicaragua, who throughout many observation and implementation of teaching strategies in their classes have expressed many of the approaches discussed in the article.

1. INTRODUCTION

Any teacher currently working for the university will have realized that the way of teaching and learning today is different from how it was done a few years ago. Why? Indeed, the rise of technologies has absorbed most of us, and especially our students. What happened then

with the way of teaching? It simply does not correspond to the way students learn, that is, many teachers teach as they did many years ago.

This can be compared to the work of a doctor, who used a certain treatment for some symptoms, but today we find many diseases with similar symptoms, but whose treatment is very different; The same happens with our students, we believe they have to do and solve the same problems, the same jobs; in short, many of us are teaching as in the ancient era, but with students of the future, and just imagining this distant comparison, it gives us an idea of the need to change the teaching practice.

Revelo Rosero (2018) points out that today, it is very common to mention the term ICT, but what we should take advantage of this, is that we can perfectly incorporate them into math classes; imagine a scenario where ICT is not incorporated and the student is asked to find an improper trigonometric integral in which he must do integration by substitution, this requires a lot of algebraic and trigonometric work; three full pages of development are filled and the answer is π , up to forty-five minutes are used for their development in classes, while for their understanding only three minutes, where many students will not have fully understood the procedure and the explanation.

Now let's think about doing the same exercise using mathematical software, it can be DERIVE, which is very easy and light to use on any computer, it takes us a minute to enter the exercise and the calculation takes less than two seconds to appear on the screen.

Many will think and say that you cannot leave the board and the marker, or the paper and the pencil, this is true, and we agree on that; nevertheless we differ from the mathematical formalism that we impregnate to the classes; fill two or three whiteboards, demonstrate to the student that teachers have mastery, ..., that is, make the subject of mathematics a demonstration moment of the teacher knowledge and not to focus on student's learning; when the ideal would be to use the result of the exercise, how it is interpreted and how it could be applied to some contextualized situation, and take the time to solve not only an example, but many examples and give the student the satisfaction that knowledge can be significant (Gutiérrez, 2018; Mendoza, Gómez and Gómez, 2018).

In a public debate, when this proposal was explained, there were teachers who supported this initiative, but the most striking thing is that there were many teachers who resisted the change. Then they were asked about what types of media they use to teach their classes and several replied that they used the television, email, WhatsApp groups, electronic screens and computers; The important thing about this is that they are already users, they just have to trained to apply these tools better. It is not just about learning these technologies, but about

using them to learn, it is a new way of thinking and working that the teacher must put into practice for the benefit of the students.

At this point, there is some resistance to incorporate these technologies because some teachers think that information technologies will replace them, but a pertinent analysis of this will say that what is thought is not true; nor is it about doing everything in digital and that this becomes a routine, but it must be a progressive adaptation of teachers so that they know, adapt and apply new work methodologies, which in the end will make the student more competent, so that they will be prepared for life (Montes, Escobar and Cadavid, 2018).

2. INCORPORATION OF TICS IN MATHEMATICS

The proposal consists of the permanent incorporation of ICTs for the development of the mathematics classes, in this sense, it is understood as: the specific softwares of each subject (Derive, SPSS, ScientificWorkPlace, Geogebra,...), the use of moodle (or something like Edmodo, Classroom), the correct use of cell phones and social networks.

The proposal may not seem innovative for some teachers who have used these tools for a long time; but it is not the case in Chontales College. It is more than proven that if the systematization and adaptation of these tools is achieved, better results can be obtained in the learning of our students (Gutiérrez, 2018).

Why incorporate ICT into math classes?

It could be thought that it is wanted to abandon the use of pencil and the paper in math classes, however, it is not the objective of this proposal; First, it has been shown that ICTs are tools for permanent and flexible learning to find particular solutions, it facilitates the student to achieve updated knowledge and can compare results with other students in a shorter time, that is, it has a multiplier effect during the process of teaching and learning (Mendoza, Gómez and Gómez 2018).

Secondly, it is known that both teenagers and adults are habitual users of these technologies, and, therefore, the university as an educational and social institution cannot turn its back and be oblivious to the culture of technology use in this changing era.

Thirdly, the university is in charge of training teachers for the different skills and abilities in the use of ICTs because this will improve the teaching and learning processes.

According to Pizarro (2009), scientific education should try to develop in students a way of thinking that combines theoretical understanding and deepening with practical activities, to which the inclusion of information technologies can greatly contribute, which should also be a reason for reformulation of the teaching of mathematics and teaching practices.

2.1. Reasons to use ICT

Teachers have thought math courses where the computer lab had to be used, it has been reflected there that students are fully motivated to have those classes, because they consider that computers are very useful and maintain interest in all the class. Thus, in the subject of basic mathematics and calculus, teachers began to program algebra practices, functions, limits, derivatives and other topics of interest, however, only with the computing and information groups. The immediate effect was that afterwards in the systematic and final evaluations the students obtained better performance than the students who did not incorporate these practices, matching to what was done by Montes, Escobar and Cadavid (2018).

Some examples found in the course of teaching work, where the need to apply ICT in math classes is evidenced:

A Group of Math students who cannot edit an exam in Word, or make an automated academic record in Excel; limited knowledge only of software to graph functions, few students have knowledge of how to use Excel or SPSS in statistics class; It is worth mentioning that when it comes to programs to evaluate derivatives, integrals or series, they have no idea how to do it with technological tools.

Likewise, some teaching actions were found in which the incorporation of technologies are not a challenge but it becomes an obstacle to education, since many teachers are only users, and they refuse to plan and practice learning with these tools, which goes against autonomous learning and collaborative learning (Abrigo, Soto and Treviño, 2018).

Another relevant finding to discuss is the use of teaching material in classrooms about five, ten or even twenty years ago. It is incredible how some of them have not read or incorporated the new ways of learning, or contextualized the theme according to our life time; teachers whose subject is conducive to use most of these tools, but they are given a more philosophical than practical treatment.

Almilla (2011) calls these faults by the teacher in the design and planning of educational programs to incorporate ICT as demagogy. Whose meaning is the refusal to perform activities of a constructivist teacher-tutor, such as planning, promoting cooperative learning and teaching the student the autonomy to decide their learning strategies.

Therefore, it is not surprising that whenever excuses are sought to justify the poor performance or quality of the teaching, all responsibility is attributed to the student, as if the teacher is not primarily responsible for the process, because after all the student will respond according to everything that is put at their disposal (Revelo Rosero, 2018).

2.2. Proposal Development

It is stated in the simplest way, the two elements on which the proposal is based; the one that contains what the teachers who teach the subject of mathematics or others must begin to carry out.

2.2.1. Objectives of the proposal:

1. To awaken the student's interest in mathematics.
2. To Link theory with practice.
3. To measure the complexity of knowledge
4. To Achieve a greater learning of mathematics.

2.2.2. Activities

1. Plan 50% of classes with technological tools (measurement).
2. Preparation of updated teaching material for the subject.
3. Development of content in the classroom 50% (whiteboard and marker).
4. Use of free platform, moddle, links, video tutorials, forums and social networks.
5. Mathematical software manipulation.
6. Learning activities on the platform.
7. Self-assessment of learning.

2.2.3. Advantages and disadvantages of the proposal

Any change brings with it different attitudes in those involved, in such an action, the existence of many developed websites where activities that will facilitate the understanding of the mathematical contents are mentioned as an advantage; the large number of virtual libraries and free access that today exists, likewise, the many free digital books of the subject, and the proper use of social networks in the exchange of experiences, which facilitates the learning of content that some students cannot understand with the use of resources provided on the platform.

The following obstacles can also be found: incorporating technologies into university education favors the challenges of learning more from the teacher, as it is not a static entity, however, they are two different generations that see things according to their objectives, and this can create a conflict in the sharing and undermine the pedagogical relationship between the

two. Not using the internet correctly can make the teacher stay in a conformism, as Marquez points out:

In spite of the great usefulness that certain resources available through the Internet represent for planning, such as data banks and bibliographic catalogs, these are used by an insignificant number of teachers, which could be caused by a lack of training policy based on the specific needs of the users. (Marquez, 2008 p.7).

In addition, it may be that many older teachers do not like to use technologies because they think they consume too much time and that it would be better to simplify the work by doing the same thing they have done throughout their teaching life and the confrontation can occur digital students versus traditional teachers, and instead of creating a climate of harmony in the subject, this becomes an obstacle to learning it.

Despite so many efforts made in the University about the issue, there are still some major problems with the use of the free platform, a few years ago, three teachers who used it, had some difficulties with the students, such as: access, data, the methodology and the evaluation, that is to say, there is not an adequate use of these tools and instead of generating a climate of confidence and a space to learn, it became a stressful and annoying moment for students and the teacher.

The use of GEOGEBRA, DERIVE, ScientificWorkPlace EXCEL and SPSS is proposed for the subjects of basic mathematics, calculations and statistics; many will think that it is nothing new, but the proposal is that this could be made permanently in all mathematics subjects; Why drift and Geogebra? The teaching experience allows to ensure that from the softwares that exist, these are the easiest and lightest (in megabyte) to use, and they are totally free.

In case of Excel and SPSS, the proposal is that these software could be always incorporated in the statistics subject, in all classes, because the interpretation of the data is more significant, than the mathematical solution. That is, why fill the board with countless formulas to find statistical indexes and statistical tests when instead of doing one or two exercises, you can analyze four or more cases and take advantage of time, because who is interested in the pages used or the time taken to calculate an ANOVA or a non-parametric test when we read an article about a study performed? Surely very few, but students are aware of the results, their interpretation and what can be concluded from the statistician.

2.3. Pedagogical basis of the proposal

From the moment in which it is decided to incorporate a new technology to the classes permanently to develop teaching-learning activities, different strategies are being directly or indirectly chosen. This is to pretend, for example, that students exercise and practice, develop simulation activities, which in turn can be planned individually or in groups (Pizarro, 2009).

Then the innovation will not only be from the technological point of view, but, in addition, by itself the proposal will allow the introduction of new approaches to teaching and learning, new teaching strategies, new ways of planning, evaluating, assigning tasks, interacting and of many other aspects; It may happen that, from the start-up, it is the most enjoyable and pleasant way chose to teach (Mendoza, Gómez and Gómez 2018).

Experience tells us that within educational theories there is not one better than another, each one has its pros and cons; For example, memorization is criticized a lot today, but if it is a question of memorizing an advertising slogan or a password, we have to memorize and so you could find examples for each of the other educational theories. The important thing is not to expect that all converge around which one is the most suitable to use together with the technologies, the important thing is to take the best of each theory and know that they complement each other.

Every time we try to apply one or another methodology, we realize that the most enveloping is the theory of diversity (which, although as an educational theory is little cited), because the interests of the students may be different from ours, and In that sense, many times there is more interest in learning what the teacher wants students to learn, but will that really be meaningful? Will student expectations be met with that? First of all, we must reflect that each of our students is very diverse, not different, because differences create conflicts or different directions, but diversity allows us to identify that each student has particular interests, and therefore teachers should create new support and attention strategies, reason why the use of technologies helps a lot to integrate all these elements in the teaching-learning process (Yáñez Ortiz and Nevárez Toledo, 2018).

The first of these is cognitive learning, which is mentioned as the process in which teachers provide students with a scaffolding system to support their cognitive growth and development. In this way, students are allowed to build their own structures through interaction. ICTs are very important tools to support cognitive learning, allowing groups to share work areas by developing collaborative activities and materials (Mendoza, Gómez and Gómez 2018).

The most present educational theories in classrooms are behaviorism and cognitivism, but they are all mixed when teaching, and the result is better learning by the student, which in the end is the great objective; with everything discussed above, the pedagogical approach that will be put into practice will be collaborative learning, this will be achieved mainly with teacher feedback (Villapando and Pantoja, 2016; Abrigo, Soto and Treviño, 2018).

And probably, if a record is kept and students actions are written during the teaching-learning process, it will be clear that there will also be difficulties, and it could lead to develop other educational methodologies and theories, which can then be shared with others companions; We

only have the challenge of incorporating them and making these technologies our way of life and work.

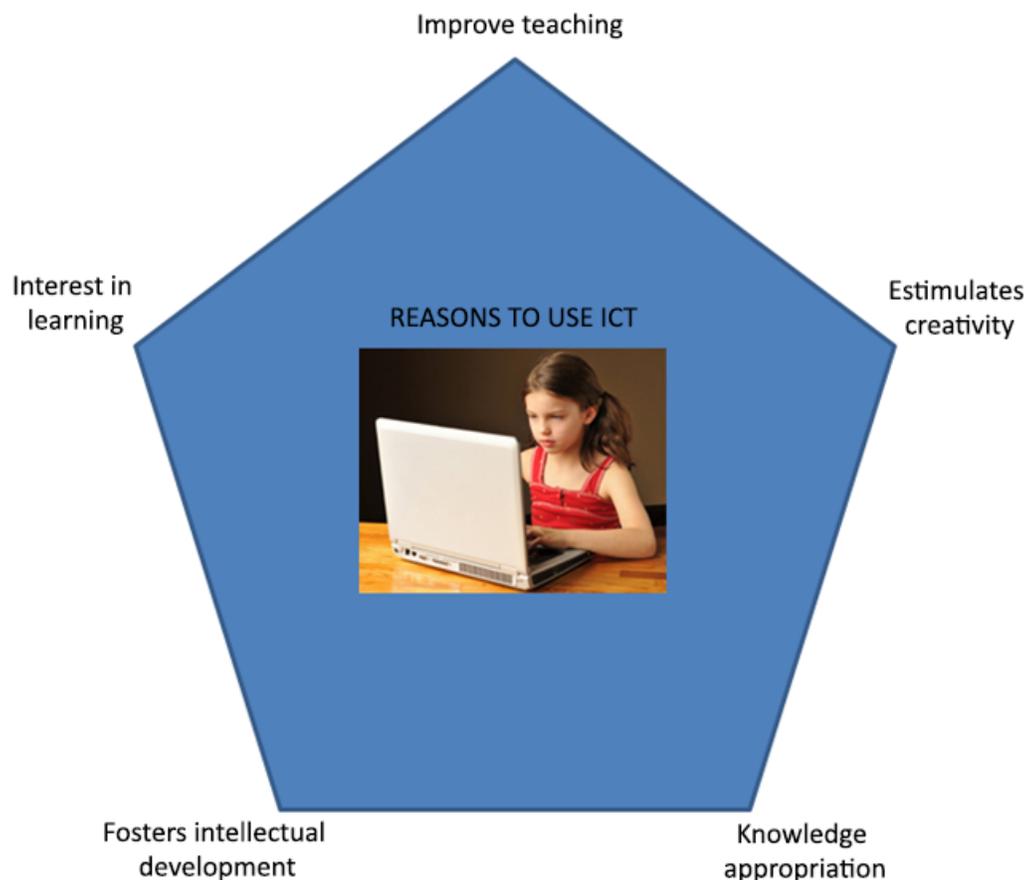


Figure 1. Reasons for impletementing ICTs (Own elaboration)

The previous figure shows the five main reasons why ICTs should be implemented in math classes. Numerous studies have shown that students' performance improves; according to the latest study done in Spain, a test was carried out in several schools in the country, both for students who did not use the computer tools and those who did use them, and it was found that in all cases the students increased the performance up to 25% above the other students. Also, interest in the class increases, there are students who do not like math on the board very much, but when they enter the computer lab or leave tasks by mail, networks or the platform, then they become more active and perform the assigned tasks, which means that it is almost a fact that math classes will gain interest and therefore motivation (Cueli, González, Rodríguez, Núñez and González-Pienda, 2018).

In the same way, technologies stimulate creativity: there are students who like to explore in detail any mathematical software that is presented to them and often ask about program

features that we sometimes did not know as a teacher, so the occasion serves a mutual learning. This does not mean that the program is ignored, but the technologies and softwares are so wide, that it would take a long time to fully understand them, but their use stimulates both the creativity and the promotion of the intellectual development of the student and teacher (Yáñez Ortiz y Nevárez Toledo, 2018; Revelo Rosero, 2018).

Under the same conditions this is the last reason to use ICTs, the appropriation of knowledge, is the most important part of our academic objective, to achieve cognitive and meaningful learning, which is only possible today with the incorporation of ICTs, in our context; The teacher who does not want to take on this challenge, possibly in a few years will not be able to teach in our university.

The emergence of Information and Communication Technologies has allowed education to reach other dimensions of great relevance. Educational software and digital platforms have undoubtedly become a fundamental tool that contributes to any form of education, since its incorporation allows both teachers and students to have a fundamental didactic tool for the development of the teaching-learning process and this means that new ways of learning are discovered and a very different teaching practice is carried out (Montes, Escobar and Cadavid, 2018; Gutiérrez, 2018; Cueli, González, Rodríguez, Núñez and González-Pienda, 2018).

CONCLUSIONS

The influence of the internet and information technologies is so great that teachers still have no idea of its dimensions; There are several reasons: first, because teachers navigate less time on social networks and with less skills than students do; second, students navigate large amounts of time alone, without guidance or orientation on what they can or should find, devoting much of that time to social networks and emails. And many teachers are in a passive state before the good use of these tools.

Traditional chairs taught in the vast majority of Nicaraguan universities are incompatible with the skills of digital students. Given this situation, the most advisable thing is that the teachers incorporate the technological tools, to know what we can teach, and that the students can learn so that they really favor significant learning.

The proposal essentially lies in the use of free and easy-to-use platforms such as Edmodo, Classroom, as well as the use of specific programs such as: Geogebra, Derive, ScientificWorkplace, Excel and SPSS; The use of these technological tools will favor and give new meaning to the teaching of mathematics in the college.

The incorporation of ICT in the area of mathematics will favor students learning, and possibly there are new ways of teaching that will be discovered; Although it is true, the use of

ICTs, as analyzed, has advantages and disadvantages, its utility is greater than the difficulties encountered; Then the university has the conditions to incorporate this proposal, as well as the staff, it is only a matter of attitude on the part of everyone involved.

The importance of its use is also stressed from the pedagogical point of view, analyzing the different educational theories, and it was found that all incorporate or raise the need to use technological tools. So, there is a challenge: to carry out this proposal, which will surely change the teacher's role in the classroom and thus be able to fulfill the mission of the Nicaraguan university and society.

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